TECHNICAL WORKSHOP

NASA-C3P

Behaviour of intact and recycled polymer concretes

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Outline

1. Objectives
2. Introduction
3. Behaviour of polymer concrete
4. Recycled PC
5. Project submitted
6. Conclusions

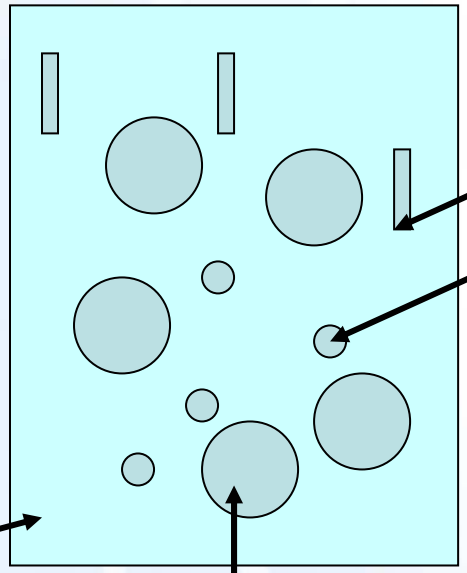
Objectives

- polymer concrete behaviour and applications
- recycled polymer concrete behaviour
- research projects

Introduction

- what is **polymer concrete**

  - ***High compressive strength***
  - ***Good chemical resistance***
  - ***Low cure time***



Fibers, recycled materials

Thermoset resin:
-Polyester
-Epoxy
-vinilester

Natural aggregates:
- sand
- gravel

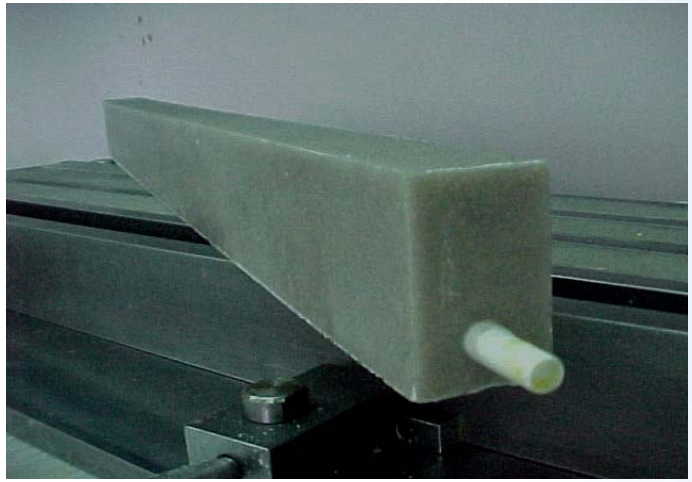
Introduction

- how **polymer concrete**

Is made

Introduction

- **what can we get**



Typical applications

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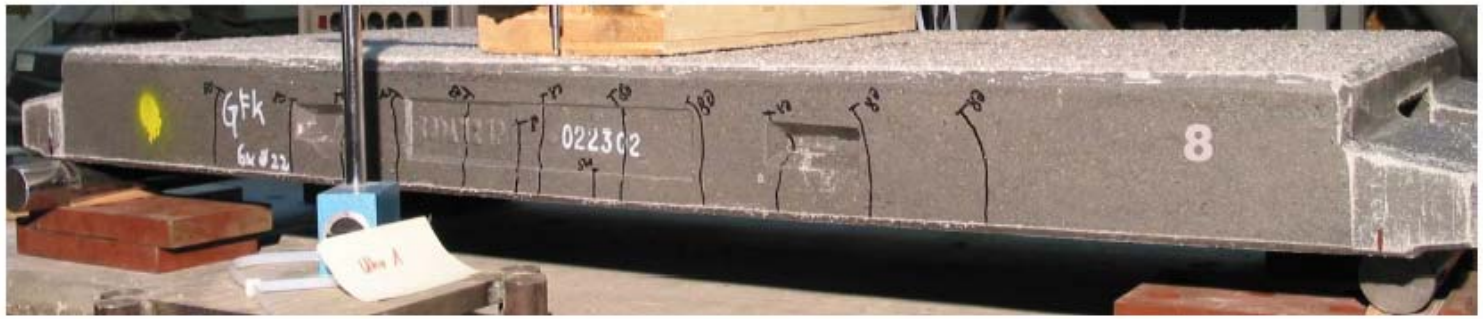
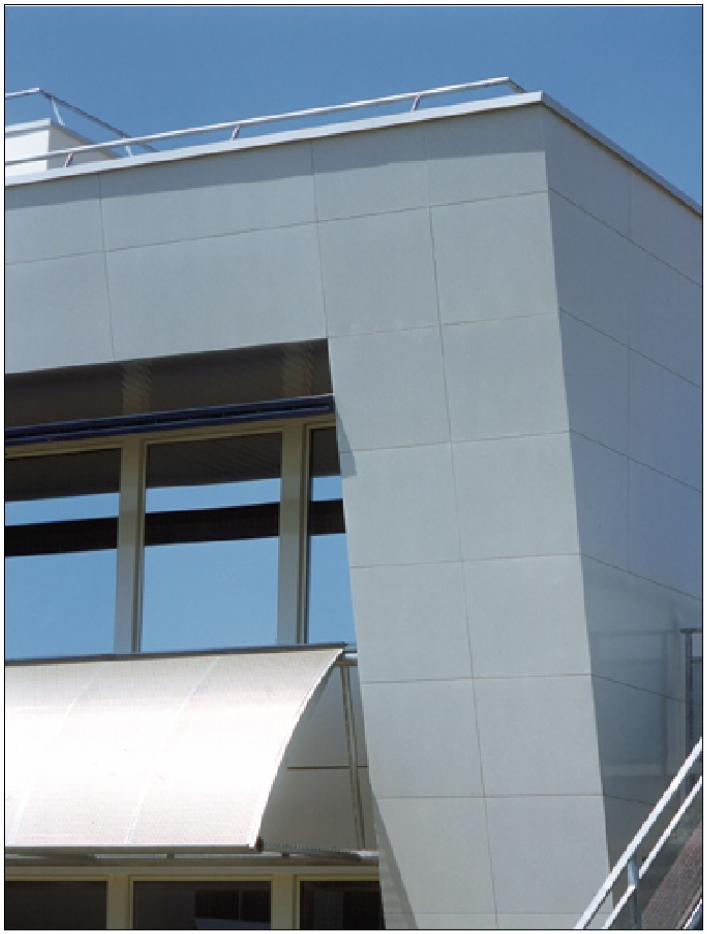


Figure 3 – Level crossing panel being load tested

Typical applications

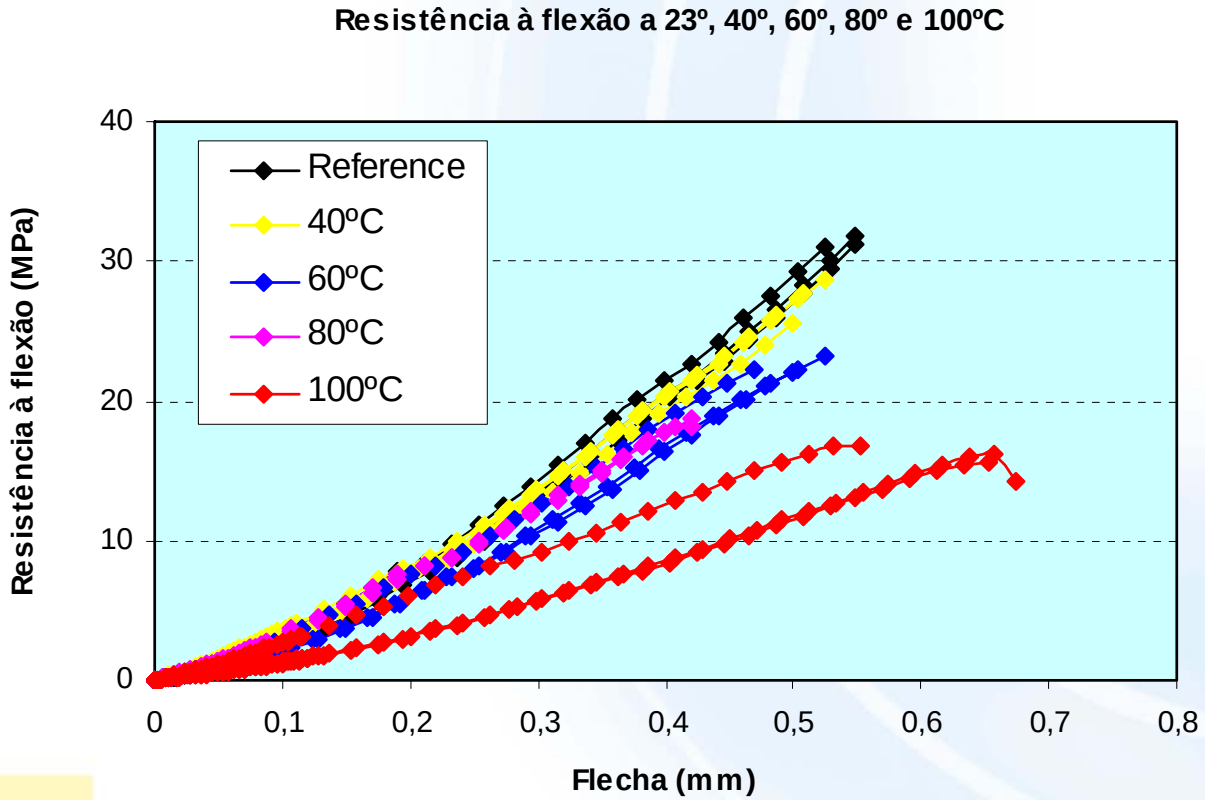
Typical applications



Typical applications

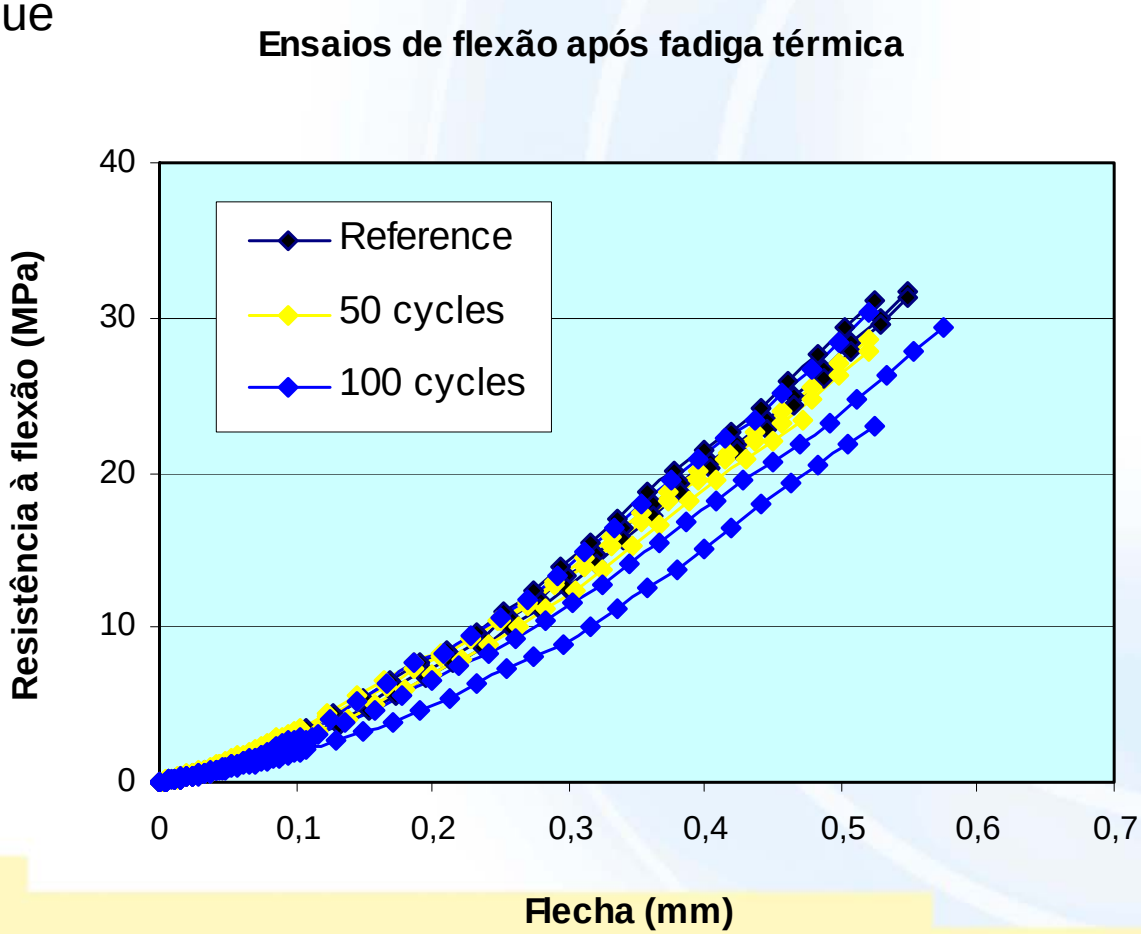
Behaviour of polymer concrete

- **bending strength vs.** temperature

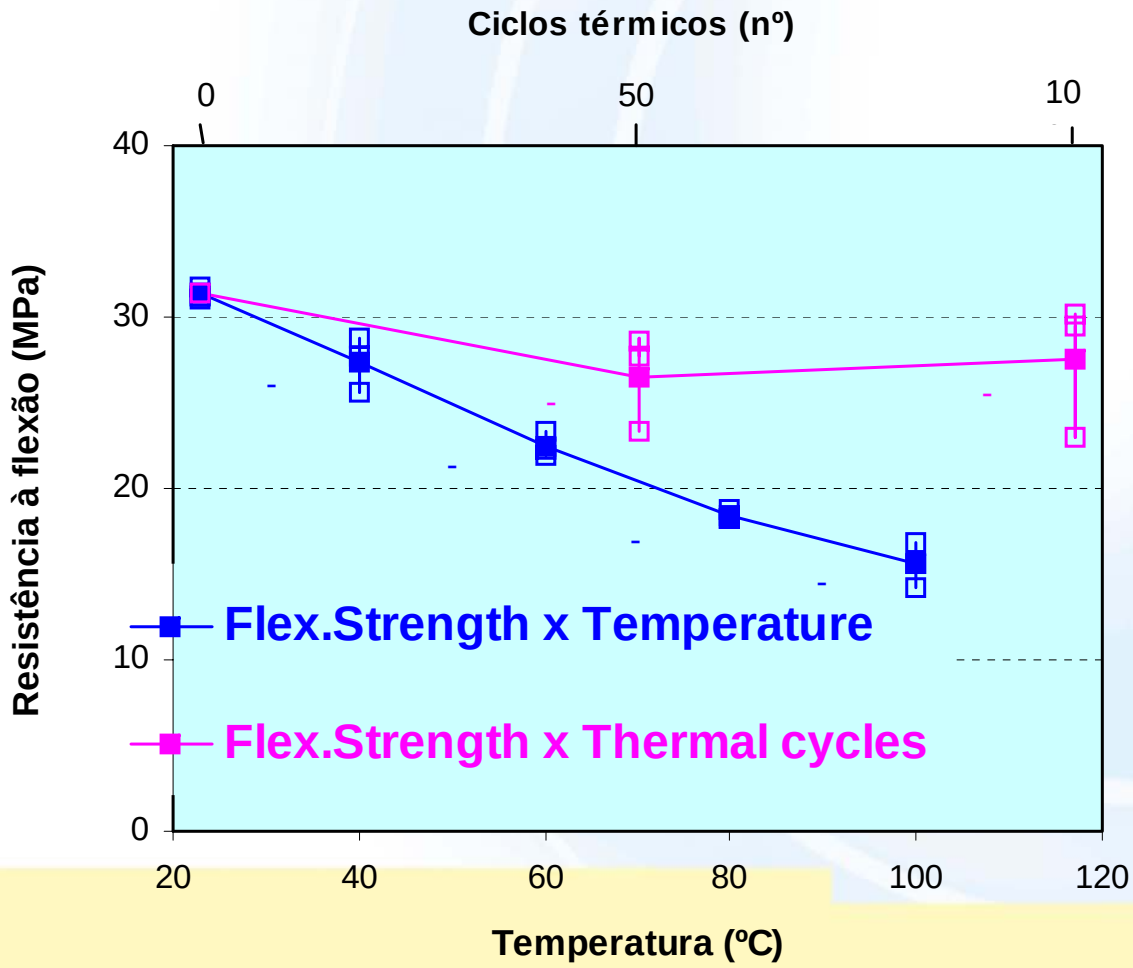


Behaviour of polymer concrete

- **bending strength vs.** Thermal fatigue

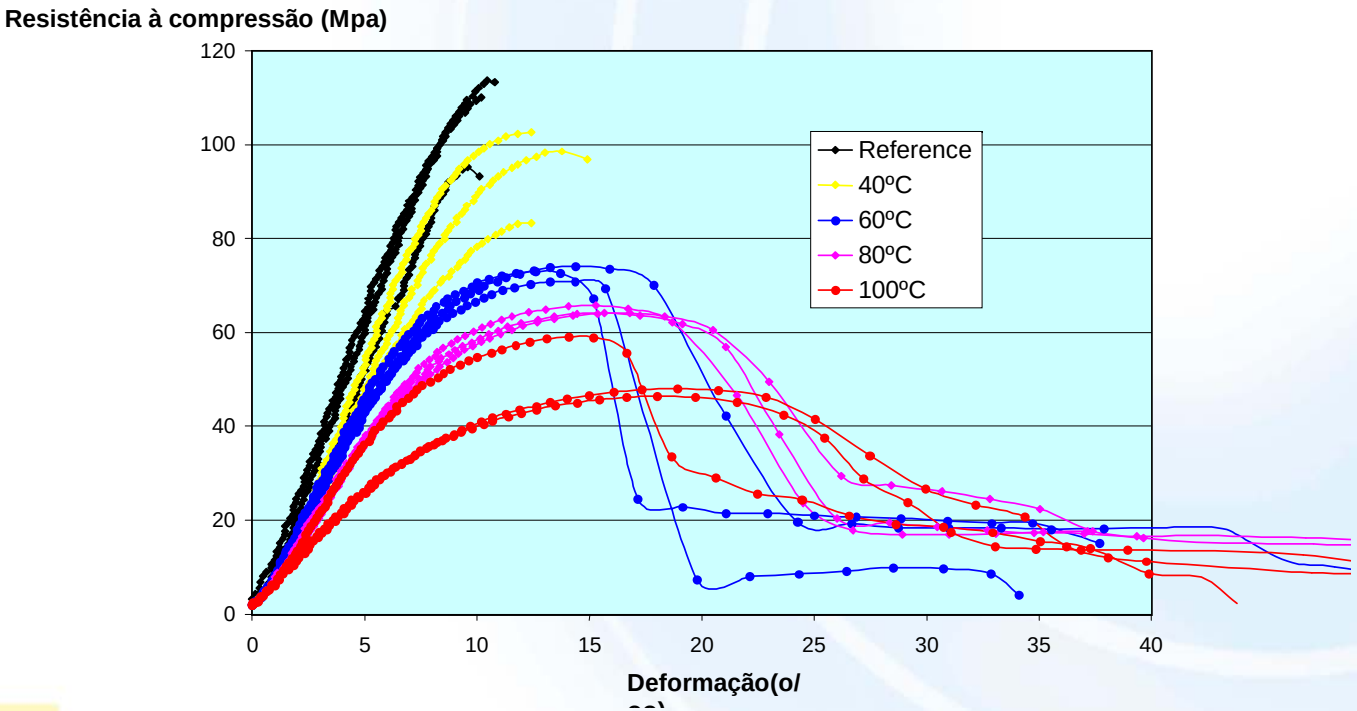


Behaviour of polymer concrete

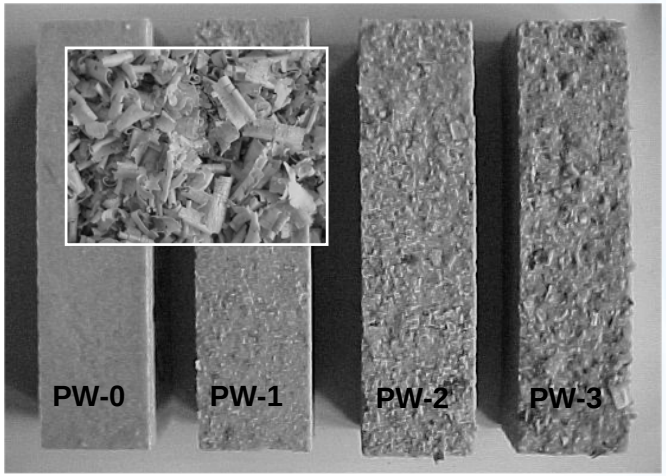


Behaviour of polymer concrete

- **compressive strength vs.** Temperature

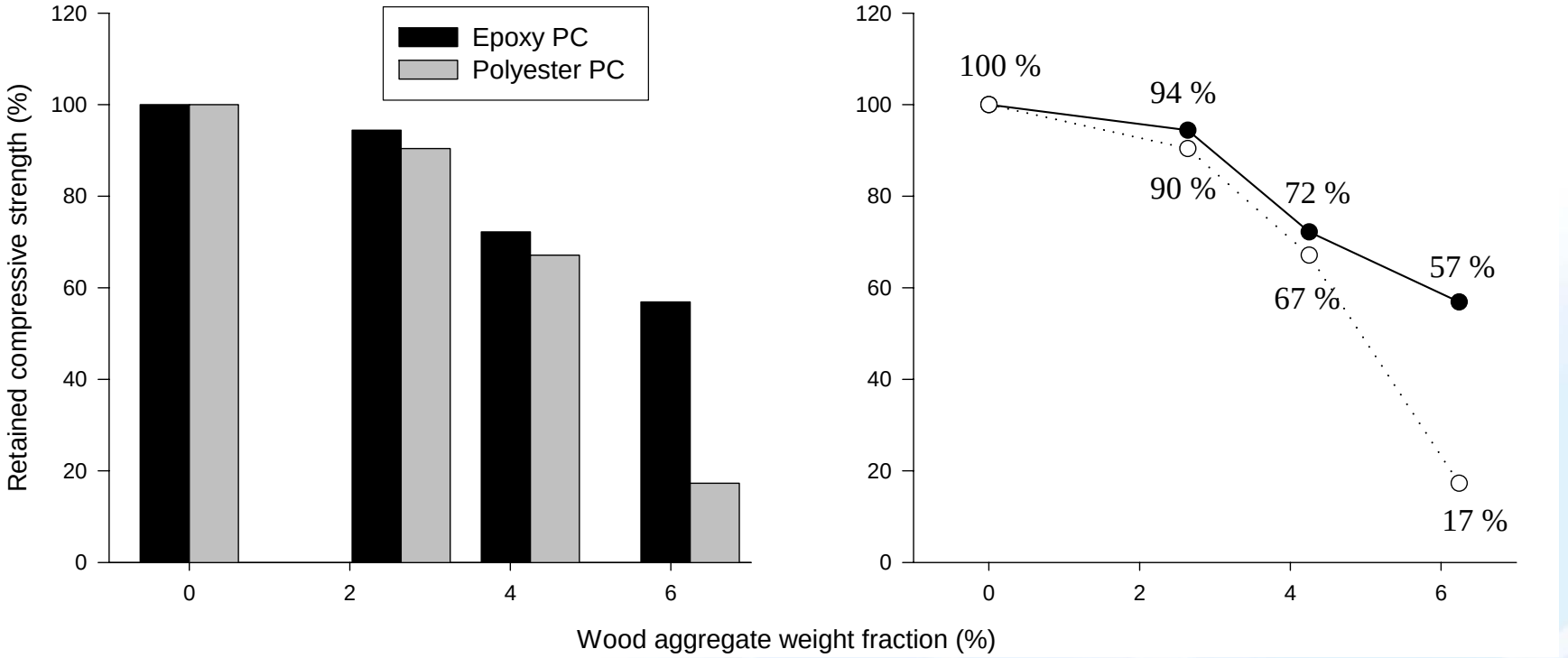


Wood-modified polymer concrete

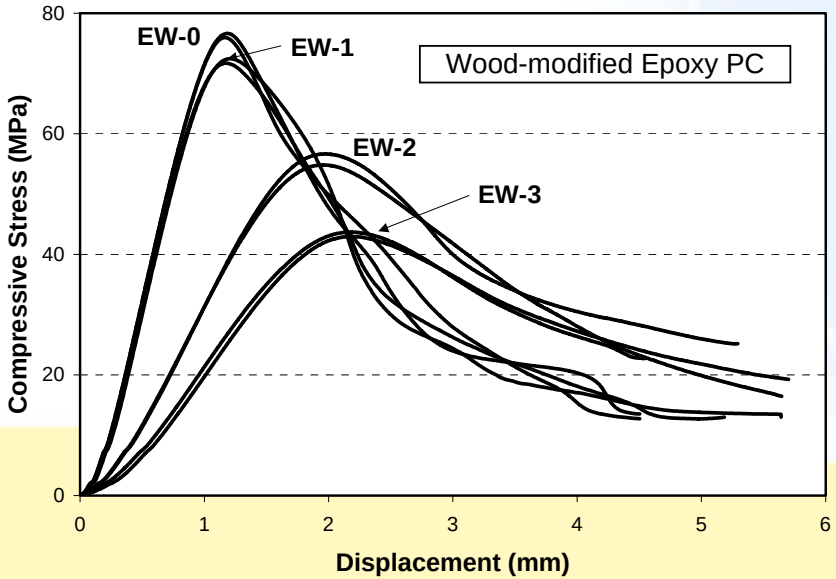


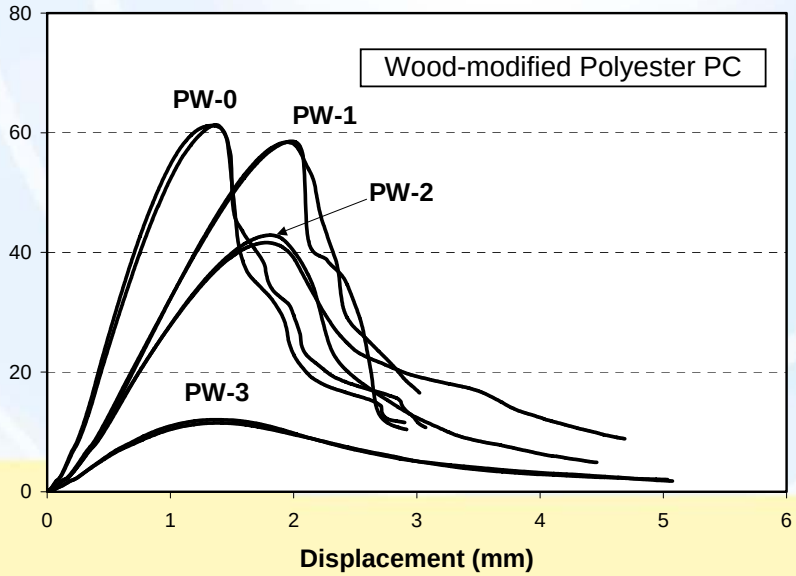
Aggregates	Density [g.cm^{-3}]	Bulk Density [g.cm^{-3}]	Average Particle Dimensions [mm]
Sand	2.65	1.56	0.24 (Ø)
Wood	0.55	0.08	15 : 7.5 : 0.3 (l:w:t)*

Wood-modified polymer concrete

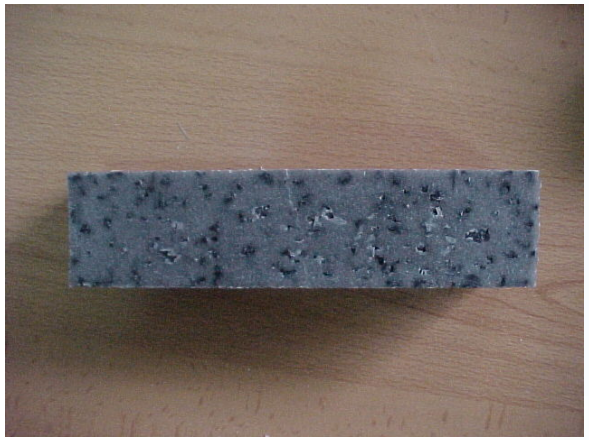


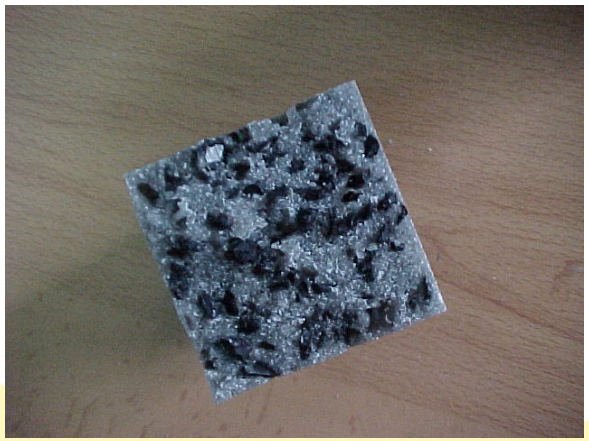
Resin Type	Test Series	Resin : Sand [w:w]	Wood : Sand [w:w]
Epoxy	EW-0	20 : 80	0 : 100
	EW-1		2.6 : 97.4
	EW-2		4.2 : 95.8
	EW-3		6.2 : 93.8
Polyester	PW-0	20 : 80	0 : 100
	PW-1		2.6 : 97.4
	PW-2		4.2 : 95.8
	PW-3		6.2 : 93.8

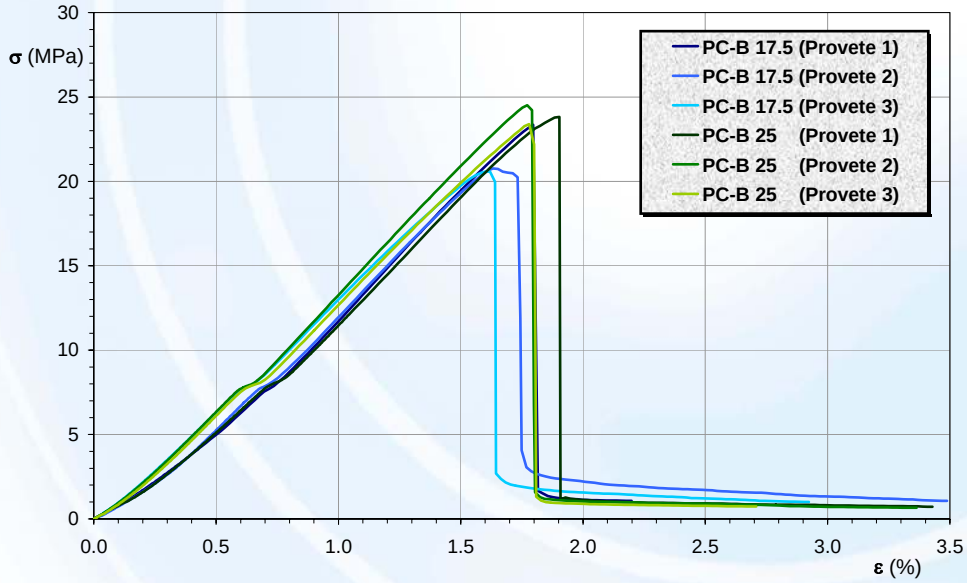




Rubber-modified polymer concrete



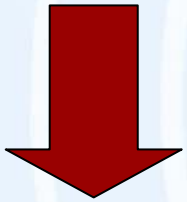




Purpose of the project

-RECYCLING OF FOUNDRY SANDS

-DEVELOPMENT OF NEW POLYMER CONCRETES WITH FOUNDRY SANDS



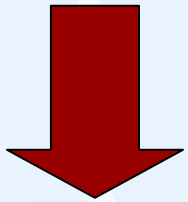
- **SOLVE A PROBLEM OF FOUNDRY COMPANIES IN TERMS OF POLLUTION LEGISLATION**
- **CREATION OF A NEW ADDED-VALUE MATERIAL**
- **REDUCTION OF COST FOR POLYMER CONCRETES**
- **CREATION OF A NICHE-MARKET**

2. The problem

- ***In 2002, 1300 tons of foundry sands*** were produced by national foundries.
- ***Resin-rich foundry sands*** are toxic materials that pollute the environment
- ***The high stock of such materials*** does not allow the re-use of the totality of stock again in foundry
- ***Other applications other than foundry*** are necessary.
- ***Foundry companies have very high costs*** to eliminate resin-rich sands. In particular, most of them are exported.

3. A solution

Recycling of foundry sands as aggregates for polymer concretes and polymer mortars; (asphalts ?)



Development of new products for the construction and public works industries

4. Advantages

- **For foundries**
  - Low-cost way of elimination of polluted foundry sands (solid waste)
  - Low-cost recycling method
- **For polymer concrete companies**
  - Low-cost raw materials
  - Lower porosity due to the compatibility of aggregate interface with resin matrix
- **For the environment**
  - Reduction of solid waste materials deposited in landfills
  - Reduction of risk materials in open air or near to water sources
  - Recycling of materials in a safe final product

5. Polymer concrete

- Materials

Polymer concrete:

Epoxy Resin
- Low Viscosity

+

Foundry Sand
- Fine Grain
- D_{50} = 342

σ_c = 82 MPa E = 11 GPa

7. Tasks

- Selection of materials
- recycling methods
- development of new polymer concretes
- characterization of materials
- production and testing of lab and real-scale prototypes

8. Project submitted- RECBETÃO

- Innovation Agency (AdI)

- Partners: ISQ, C3P, Artiportela, Arsopi

Conclusions

- polymer concrete is a high strength concrete

- It incorporates easily other materials

- recycled concrete still is a competitive material

- foundry sands are one big opportunity

- rubber from tires another opportunity

Acknowledgement

Prof. Silva Gomes (FEUP/INEGI) for continuous support and encouragement during project preparation